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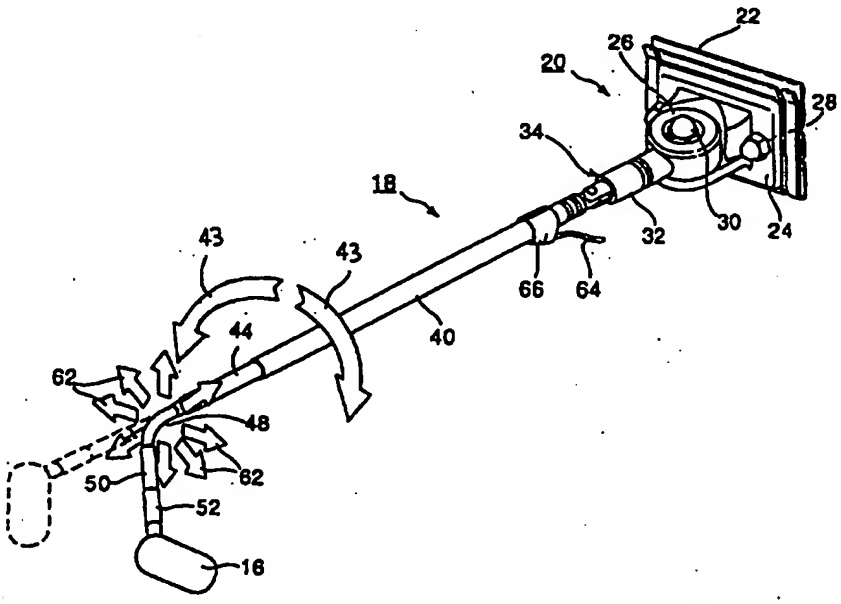
(54) Title: MICROPHONE MOUNTING ARM ASSEMBLY

(57) Abstract

A microphone mounting arm assembly (10) for vehicles (12) is provided, whereby a microphone element (94) for wireless communications such as cellular telephones, or citizens' band or two-way radios, is installed in the vehicle in such a manner that the microphone element may be selectively positionable near the mouth (15) of the user (14) so that the radio frequency operating device may be used for speech in a hands-free manner. The microphone mounting arm assembly is folded up, out of the way, typically over the driver's door, and is adjusted by various pivotal and swivel movements, telescopic arm length extension, and by a gooseneck (48) for final positioning of the microphone in the region of the mouth of the driver. The voice wires (106, 108), and power wires (114, 116) for the microphone element when it is a condenser microphone, pass through the microphone mounting arm assembly so as to provide radio frequency shielding therefor. The microphone mounting arm assembly is mounted on an electrical insulating base (20) so that it is electrically isolated from the body of the vehicle, and so as to preclude hum due to ground loops occurring in the audio frequency portion of the telephone or radio installation in the vehicle. A mounting clip (22) is provided so that the microphone mounting arm assembly may be removably installed in the vehicle without the necessity for drilling holes, by being mounted to door trim or the head liner of the vehicle. Superior voice transmission from the vehicle to the party being called is achieved, in a hands-free operating mode, without obscuring the driver's vision.



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MICROPHONE MOUNTING ARM ASSEMBLY

FIELD OF THE INVENTION:

This invention relates to microphone installations for cellular telephones in vehicles. More particularly, this invention is directed to the electrical considerations surrounding the mounting and placement of a microphone in the interior of a motor vehicle, where the microphone is connected to a cellular telephone so as to substitute for the mouthpiece thereof, as well as to the mechanical aspects of mounting a microphone arm for easy manipulation by the driver of the motor vehicle.

BACKGROUND OF THE INVENTION:

Mobile cellular telephones for use in vehicles have become very commonplace over the last ten years or so. There are two conventional ways to use a mobile cellular telephone in a vehicle. The first way is to use the telephone handset in the same manner as one would use the handset of a conventional fixed telephone, such as those found in a home or office, wherein the handset is grasped in the user's hand. Use of a mobile cellular telephone in this manner while a vehicle is stationary — in other words, a person is not driving — or by a person in the vehicle other than the driver, is generally quite safe and acceptable; however, use of a mobile cellular telephone in the above described manner by the driver of a vehicle, while operating the vehicle, can be quite dangerous and is considered by many law enforcement agencies to be dangerous enough to force motorists to stop the vehicle or at least hang up the phone.

In order to promote safety while driving a vehicle, it is alternatively possible for the driver of a vehicle to use a mobile cellular telephone by means of a hands-free operation. Typical equipment for hands-free operation includes a remote microphone placed somewhere in front of the face and mouth of the driver, for example on the sun visor in the vehicle, which microphone is used to pick up the driver's speech; together with an audio speaker within the vehicle which is used to produce sound corresponding to the incoming signal to the

mobile cellular telephone, which sound represents the voice of the person being communicated with. While this hands-free operation is quite safe in that it permits the driver unrestricted freedom to properly operate the vehicle, it is common knowledge that the hands-free method of receiving the voice of the driver by a remote microphone produces very poor results. There are several reasons for this: Typically, the hands-free microphone is located on the interior surface of the vehicle at a distance of perhaps one foot, or more, away from the driver's mouth. This distance is much too far away from the driver's mouth to properly pick up the driver's speech, and the visor-mounted microphone will pick up an excessive amount of noise. Thus, it is hard for the listener at the other end of the call to distinguish the caller's voice from background noise. A placement distance for the microphone of about 6 to 20 centimeters, and usually about 10 centimeters, is more appropriate. Also, most microphones used for hands-free operation of a cellular telephone in a vehicle are omni-directional, which therefore increases the tendency to pick up a significant amount of ambient noise, since the microphones cannot distinguish between speech and noise. Also, such microphones generally tend to be of poor quality, in any event.

In order to overcome the problems that arise by use of a conventional remote microphone placed in the interior of a vehicle, it is best to provide a means for placing a microphone — preferably, such as a higher quality, powered condenser microphone — near the driver's mouth, so as to provide for high quality speech pick-up during hands-free operation of a cellular telephone. there are two possible alternatives to achieve these ends. The first alternative is for the driver to wear a headset having a microphone on an arm extending to the area in front of the driver's mouth; however, it has been found that most drivers resist wearing such a headset, for a variety of reasons, such as increased risk of breakage, the requirement to constantly take off and put on the headset, and the fact that the headset may be restrictive and cumbersome. This alternative is, therefore, generally unacceptable.

The other means by which a microphone can be placed properly near a driver's mouth, so as to readily pick up the speech from the driver's mouth, is to

place the microphone on a specially designed arm. Such a specially designed arm would have one end mounted at a suitable position on the interior of a vehicle, and would have the microphone placed on the opposite other end of the arm.

It must be understood that a microphone, even on a specially designed arm, will not by itself be able to distinguish speech from ambient noise, and noise from within the vehicle could be picked up by the microphone, in addition to speech from the driver. It is therefore necessary to direct the microphone towards the driver's mouth and also to bring the microphone as close as reasonably possible to the driver's mouth, preferably within about 6 to 20 centimeters, in order to reduce unwanted noise. Still further, as noted below, it is advantageous to use a microphone which is unidirectional, and with a narrow active field and a small pick-up pattern. Even further, as discussed hereafter, it is advantageous to use a powered condenser microphone.

A microphone mounted on a specially designed arm must overcome a number of problems in order to produce a useful and acceptable result in terms of sound quality.

First of all, the microphone should be situated generally in front of the driver's mouth, preferably at a distance of about 6 to 20 centimeters, and usually about 10 centimeters, from the driver's mouth. The arm, therefore, needs to be movable so that the end of the arm where the microphone is mounted is selectively positionable in the vicinity of the driver's mouth, keeping in mind that the location of the driver's mouth is not fixed. Such selective positioning can best be accomplished by means of having the arm pivotally mounted on a base and also having the arm adjustable in terms of length. The pivotal mount must be mounted in axially rotatable relation with respect to the base in order to permit the microphone to be selectively positionable three dimensionally.

Having an adjustable length arm causes another problem, in that the wire attached to the microphone, which wire feeds through the arm, must move freely into and out of the arm where it enters the arm, without ripping the wire.

Preferably, as discussed above, the microphone should have a very small pick-up pattern, and it should be relatively unidirectional. Accordingly, the angle

of orientation of the microphone at the end of the specially designed arm must be fully adjustable, so as to be directable at a driver's mouth. Also, the telescopic arm should be axially rotationally adjustable so as to permit angular adjustment of the microphone at the driver's mouth.

When not in use, the specially designed arm must fold away, preferably up against the interior of the vehicle at the roof line thereof, so as to be out of the way and so as to be clear of the driver's vision. Further, it must stay out of the way when not in use, and also be very easy to bring back down into place for use, requiring only one hand to do so. It should also be very small and unobtrusive so as to not obscure the driver's vision; and also it should not reflect light significantly, if possible. Also, the arm must be small and light weight and otherwise designed so as to not cause injury in the event of impact with a driver, which impact would typically be with driver's head.

In spite of the fact that the arm must be readily adjustable in terms of positioning, it must also be strong enough to withstand vibration within the vehicle, such vibration occurring as a result of general automobile vibration and also as a result of bumps encountered by the vehicle while driving. The arm must handle these bumps without moving significantly, both in a retracted position and an in use position when the microphone is at the driver's mouth. Further, such vibration and bumps must not cause noise in the microphone.

Another problem concerning the positioning of the microphone in front of the driver is that of mounting the specially designed arm within the vehicle, typically on the interior lining of the vehicle. Preferably, there should be no holes required to mount the arm, and also the mounting should be adjustable so as to compensate for the roof line angle. The arm should also be removable in the event that it is to be transferred to another vehicle.

Indeed, it should be noted that positioning of a microphone in front of the driver of a vehicle may have widespread applications, above and beyond the typical use in association with a cellular telephone which is mounted in or being carried within the vehicle. For example, truck drivers and others will find the microphone mounting arm assembly of the present invention particularly

applicable to citizens' band (CB) radios; and there are many other radio frequency operating installations for a vehicle which might also include trunk operating two-way radio installations, or non-trunk operating two-way radio installations. Examples of the former may be police or fire installations, taxi cab installations, and the like; examples of the latter may be point-to-point installations used in corporate vehicles, courier delivery and pick-up vehicles, and the like.

In any event, another important consideration is that of proper electrical grounding of the microphone and the arm in a vehicle. The microphone and arm must be electrically grounded to each other and to the cellular telephone or other radio frequency operating installation, so as to preclude static pop when the microphone is touched. Moreover, if a condenser microphone assembly is being employed, there is a requirement for a constant neutral connection throughout both the DC power line supplying DC power to the condenser microphone, and the voice signal lines carrying the voice signals away from the microphone to the radio frequency operating installation. However, the microphone and arm should not be locally electrically connected to the body of the vehicle, because of the tendency for hum or other noise due to ground loops, to occur.

Further, if the microphone and radio frequency operating installation ground or neutral connection is to be grounded to the chassis of the vehicle, it is important that the ground connection be made to the ground of the vehicle at a single point only. This also precludes inadvertent grounding of the microphone to the vehicle except at a single point — if at all. As noted above, if the microphone is grounded to a different point than the cellular telephone, a ground loop could be set up, thus potentially causing hum in the audio circuit of the cellular telephone. That hum may be loud enough to significantly interfere with the voice signals so that the person listening to the receiving telephone may be incapable of recognizing the words being spoken.

Another important consideration is that of electrical radio frequency interference from the vehicle's electrical system and from other radio frequency transmissions external to the vehicle — commonly known as "RF blowthrough". RF blowthrough may cause other voice signals to be heard, it could cause a whine

or siren-like effect, or a white noise effect, so as to interfere with the voice signals coming from the microphone. RF blowthrough can be overcome by using the specially designed arm as a primary shield for the wires that connect to the microphone.

SUMMARY OF THE INVENTION:

In accordance with one aspect of the present invention, there is provided a microphone mounting arm assembly for a microphone in a radio frequency operating installation in a vehicle, which radio frequency operating installation includes a microphone assembly, a radio frequency transmitter and a radio frequency receiver which function together as a radio frequency operating device, an antenna, an amplifier, a signal convertor, and a source of direct current power which provides the operating power for at least the amplifier, signal converter, and radio frequency operating device. The microphone assembly is mounted in a vehicle on a mounting arm so that it may selectively positionable near the mouth of the user of the radio frequency operating installation.

The microphone assembly includes a microphone element which is connected to the amplifier by at least a voice neutral and a voice signal wire. The mounting arm is constructed of an electrically conductive material and is a hollow tube; and the voice neutral wire and the voice signal wire are passed through the hollow tube of the mounting arm from the microphone element. The microphone assembly further includes a microphone shield element which is electrically connected to the mounting arm. The mounting arm is secured to an electrically insulating base which is mechanically mounted at a mounting position on an interior surface of the body of the vehicle, the arrangement being such that the microphone shield element and the mounting arm are thereby electrically isolated from a vehicle ground and, moreover, they provide radio frequency shielding for the microphone element and for the voice signal wires that are passed through the mounting arm.

Typically, as noted above, the radio frequency operating installation may be a cellular telephone installation, but it may also be a CB radio installation, a

trunk operating two-way radio installation, or a non-trunk operating two-way radio installation.

In accordance with another aspect of the present invention, there is provided a microphone mounting arm for mounting a microphone assembly in a vehicle. The microphone assembly includes a microphone element of a radio frequency operating installation for the vehicle, which radio frequency operating installation further comprises at least a radio frequency transmitter and a radio frequency receiver which function together as a radio frequency operating device, and wherein the microphone assembly is connected to the radio frequency operating device and is mounted so as to be selectively positionable near the mouth of the user of the radio frequency operating installation.

The microphone mounting arm comprises a fixed base member which is adapted for secure mounting onto a mounting clip, and a pivot base member which is mounted to the fixed base member for selective pivotal movement about a first pivot axis so that it may be moved to a plurality of angled positions. At least one of the fixed base member and the pivot base member is electrically insulative.

The pivot base member includes a substantially cylindrical stem-receiving socket, and has a rotatable stem which has a longitudinal axis, and first and second ends. The first end is inserted into the stem-receiving socket for selective rotational movement about the longitudinal axis. A pivot yoke projects outwardly from the second end of the rotatable stem. There is provided an elongate main arm which has first and second ends, with a pivot stem projecting outwardly at the first end and being retained by the pivot yoke of the rotatable pivot stem so that pivotal movement of the elongate main arm is possible about a second pivot axis, through a continuum of angled positions. The elongate main arm also includes at least one telescopic element which is inserted into it at its second end. There is provided a gooseneck element which is mounted on the at least one telescopic element at the end thereof which is remote from the end which is inserted into the second end of the elongate main arm. The microphone assembly which contains the microphone element is mounted at the gooseneck element at

the end thereof which is remote from the at least one telescopic element. The arrangement is such that the microphone assembly may be selectively positionable near the mouth of the user by selective adjustment of any of the pivot base member about its first pivot axis with respect to the first base member, the rotatable stem within the stem-receiving socket for rotational movement about its longitudinal axis, the elongate main arm about the second pivot axis with respect to the rotatable stem, or by telescopic adjustment of the at least one telescopic element with respect to the elongate main arm, or by adjusting the gooseneck element.

Yet a further aspect of the present invention provides for a mounting clip that is intended for use with a microphone mounting arm assembly for mounting the microphone mounting arm assembly in a removable manner to a mounting position on the interior of a vehicle passenger compartment. The microphone mounting arm assembly includes an electrically insulating base which is intended to be received by and secured to the mounting clip; and the mounting clip comprises a main body having front and rear panels that are joined together as a unitary body along their respective bottom edges. The unitary body is formed from a resiliently deformable material which has a modulus of elasticity such that the front and rear panels are openable and elastically closeable one with respect to the other at their top edges. The insulating base may be placed into an insulating base receiving means which is disposed on the front face of the front panel of the unitary body; and there are a plurality of spaced apart prongs which project outwardly from the front face of the rear panel and generally towards the front panel. The prongs are each shaped and dimensioned to engage the material on the interior of a vehicle passenger compartment in supported relation thereon. That material may be the head liner material, or it may be the trim material around the driver's door of the vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS:

Embodiments of this invention will now be described by way of example in association with the accompanying drawings in which:

Figure 1 is generally illustrates a microphone and mounting arm assembly, together with its mounting clip, installed in the interior of a vehicle with the microphone mounting arm being folded away and not being in use;

Figure 2 is similar to Figure 1 but showing the microphone mounting arm assembly and the microphone mounting arm being in use;

Figure 3 is a perspective view of the microphone and mounting arm assembly, and mounting clip, showing a first adjustment position whereby the microphone assembly may be adjusted to be selectively positionable near the mouth of the user;

Figure 4 is similar to Figure 3, and shows a second adjustment manner whereby the microphone assembly may be adjusted to be selectively positionable near the mouth of the user;

Figure 5 shows a third adjustment manner whereby the microphone assembly may be adjusted to be selectively positionable near the mouth of the user;

Figure 6 shows a fourth adjustment manner by which the microphone assembly may be adjusted to be selectively positionable near the mouth of the user;

Figure 7 shows a fifth adjustment manner by which the microphone assembly may be adjusted to be selectively positionable near the mouth of the user;

Figure 8 is a plan view showing further details of the microphone mounting arm assembly including the microphone mounting arm and mounting base;

Figure 9 is an elevation view similar to Figure 8;

Figure 10 shows in greater detail the manner by which wires installed within the interior of the mounting arm may exit the arm near the base thereof;

Figure 11 is an electrical schematic showing the principal manner of electrical installation of a microphone mounting arm assembly in keeping with the present invention; and

Figure 12 is perspective view showing certain details of a mounting clip

in keeping with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Referring first to Figures 1 and 2, a microphone mounting arm assembly 10 is shown being mounted in a vehicle 12 in which a driver 14 is seated. In the arrangement shown in Figure 1, the microphone mounting arm assembly 10 is folded back out of the way, over the driver's door, and against the head liner in the vehicle. In Figure 2, the microphone assembly 16 is shown having been placed generally near the mouth 15 of the driver 14.

By being placed in the vehicle 12 in the manner shown in Figures 1 and 2, it is evident that the microphone mounting arm assembly, including the microphone assembly 16, the mounting arm shown generally at 18, an electrically insulating base 20, and a mounting clip 22, are mounted in the vehicle 12 so as to be out of the way in Figure 1, and in operating position in Figure 2. Thus, the microphone assembly 16 is selectively positioned near the mouth 15 of the driver 14. However, the positioning is also in such a manner that, in the event of a collision, where the head of the driver might be propelled forward, the microphone mounting arm assembly will swing upwards and out of the way without sustaining any or any appreciable damage, and without causing damage or injury to the driver's head.

Accordingly, and as will be discussed hereafter, the present invention provides a microphone mounting arm assembly for use in a vehicle in association with a radio frequency operating installation, such as a cellular telephone, whereby the microphone is strategically placed and the mounting arm on which it is fixed is capable of complex movement so as to be safely and easily used by the driver of the motor vehicle while he is operating the motor vehicle.

Also, as will be discussed in greater detail hereafter, by using a special purpose clip which comprises one of the features of the present invention, there is no necessity to drill holes in any part of the vehicle body, and yet the mounting arm may be safely and securely placed in position. As described in greater detail hereafter, the clip is such that it may be mounted to the roof or head liner of the

vehicle, or it may be mounted or clipped to the trim or molding such as the head liner trim over the door of the vehicle, and the clip and the associated microphone mounting arm assembly will remain securely and safely in place. However, by not having to drill holes or otherwise secure the microphone mounting arm assembly by threaded fasteners or the like to the vehicle, it is obvious that the assembly may be removed from one vehicle and easily transferred to another vehicle.

As will be described hereafter, the mounting arm of the present invention is made from an electrically conductive material. However, it is mounted on an electrically insulating base so as to be electrically isolated from the body of the vehicle. If the radio frequency operating installation — as noted, typically a cellular telephone, to which the following discussion is particularly directed — is permanently fixed within the vehicle, or even if it is such that a microphone may be plugged into the radio operating device in one way or another, and if the radio frequency operating device is connected to the vehicle ground, there may be significant noise or other hum or whining sounds heard by another party being called from the vehicle. Thus, care must be taken when the radio frequency operating device is to be grounded to the vehicle chassis. Particularly with such installations as cellular telephones, having an antenna which is mounted to a window of the vehicle, all components of the installation may be effectively isolated from the vehicle ground. However, if the installation is being powered by the vehicle battery, it may be necessary for there to be a single ground connection between the grounding structure provided for the radio frequency operating installation and the vehicle ground. Most often, of course, the vehicle ground is electrically determined to be the chassis of the vehicle, to which one side of the battery installed in the vehicle is connected. However, if there is more than one ground connection in a vehicle mounted system where audio frequency signals will be transmitted or handled in any way, especially where there may be electrical resistance through the vehicle chassis between different ground connections, then ground loops may develop. They may result in annoying hum or whining sounds, which may make it impossible to distinguish between speech

and noise.

Still further, as will be noted below, there is also a risk that radio frequency interference may impose itself on audio frequency signals, resulting in such annoying distractions or interference as "cross talk", a whine or siren like noise, white noise, and the like. Accordingly, one feature of the present invention is to ensure that the so-called radio frequency interference or "RF blowthrough" is guarded against and essentially precluded. This is accomplished by passing voice signal wires, in particular, through the interior of a hollow mounting arm which is electrically conductive and which serves to provide for radio frequency shielding.

In order to provide for the quite extensive manner by which the positioning of a microphone assembly in the vicinity of the mouth of the driver may be accomplished, the microphone mounting arm as particularly shown in Figures 3 through 10, is now described.

The mounting arm assembly shown generally at 18 is shown in a plurality of positions, and its adjustment is shown in a variety of ways, in Figures 3 through 7. The microphone assembly 16 is mounted at one end of the mounting arm assembly 18, at the other end of which is a base shown generally at 20, and a mounting clip shown generally at 22. There is, indeed, a fixed base member 24 which is adapted for secure mounting onto the mounting clip 22, and a pivot base member 26 which is mounted to the fixed base member 24 and is arranged for selective pivotal movement. The fixed base member 24 is secured to the clip 22 such as by screw fasteners 28; and the fixed base member 24 and pivot base member 26 are secured to each other by a base mounting pivot bolt 30. It is evident that the axis of the base mounting pivot bolt 30 also provides a first pivot axis for selective pivotal movement of the pivot base member 26 relative to the fixed base member 24. A plurality of angled positions to which the base member 26 may be moved relative to the fixed base member 24, can be accommodated by the provision of suitable detents in the faces of the fixed base member 24 and the pivot base member 26 which are opposed to each other and which are in contact with each other. At least one of the fixed base member 24 and the pivot

base member 26 is made of an electrically insulative material. It has been found that such material may, for example, be any one of nylon, polypropylene. polyvinylchloride, or polyethylene. Electrically insulating nylon of the same material from which hard hats for use by construction workers' are manufactured. is particularly useful.

It will be seen that the pivot base member 26 is also molded or formed so as to include a substantially cylindrical stem-receiving socket 32. There is a rotatable stem which is shown generally at 34, and it has a first end which is inserted into the stem-receiving socket 32. The rotatable stem has a longitudinal axis along its length, and thus the rotatable stem is received for selective rotational movement about the longitudinal axis in the stem-receiving socket.

At the outer or second end of the rotatable stem 34, there is pivot yoke 36; and it is adapted to receive a pivot stem 38 which is formed at the first end of an elongate main arm 40. The pivot stem 38 is retained in the pivot yoke 36 such as by a pivot mounting screw 42; and it is evident that the axis of the pivot mounting screw 42 provides a second pivot axis about which the rotatable pivot stem 38 may be rotated through a continuum of angled positions.

The elongate main arm 40 has at least one telescopic element 44 inserted into and extending from the elongate main arm 40 at the second end thereof remote from the pivot stem 38. There may also be a further or second telescopic element 46 inserted into and extendable from the first telescopic element 44. The telescopic element 44 may be rotatable in the respective main arm 40, as shown by arrows 43 in Figure 7, so as to provide further adjustment. This may be especially useful when the mounting arm assembly is swung up from in front of the face of the driver, as shown in Figure 1; or to provide further fine adjustment of the placement of the microphone assembly 16 as shown in Figure 2, and may be rotatable in the telescopic element 44.

Mounted at the outer end of the telescopic element 44, or telescopic element 46 if present, there is a gooseneck element 48. The gooseneck element permits an extensive number of adjustment positions, due to its own typical gooseneck construction and configuration.

At the end of the gooseneck element 48, there may be a further extender arm 50; and in any event, the microphone assembly 16 is mounted at the end of the mounting arm assembly 18 beyond the end of the gooseneck element 48 which is remote from the base 20. The microphone assembly 16 may be mounted either to the gooseneck element 48 or the extender arm 50 such as by a mounting sleeve 52.

It has been found that the telescopic element 46 might be slightly loosely fitted with respect to the telescopic element 44, especially through use, as might the gooseneck element 48 with respect to the telescopic element 46. Accordingly, the relative rotational positioning of the microphone assembly 16 with respect to the fixed base member 24 may not be positively fixed, in use. It has also been found that a loosely fitted connection between the telescopic element 44 and the telescopic element 46, if used, and in any event between the telescopic element 44 or 46 and the gooseneck element 48 might cause interruption of electrical continuity between these elements, thus causing an interruption of the radio frequency shielding provided by the arm structure, as discussed hereafter.

In order to securely interconnect the telescopic element 44, the telescopic element 46, and the gooseneck element 48 one to the other, a metal collar 45 is secured in place over a portion of the telescopic element 44, adjacent the gooseneck element 48. If the telescopic element 46 is present, it is generally covered by the metal collar 45. A set screw 47 threadibly engages a co-operating aperture (not shown) in the metal collar 45 so as to contact the metal collar 45 in electrically conductive relation, passes through another aperture (not shown) in the telescopic element 44 while contacting the telescopic element 44 in electrically conductive relation, also passes through another aperture (not shown) in the telescopic element 46 while contacting the telescopic element 46 in electrically conductive relation, if the telescopic element 46 is present, and tightens against the gooseneck element 48. In this manner, the telescopic element 44, the telescopic element 46, and the gooseneck element 48 are mechanically secured in non-rotating relation one to another, and also are electrically connected one to another. As noted above, each of the fixed base member 24 and the pivot

base member 26 may comprise a plurality of co-operating detent portions which interact with the detent portions on the other of the fixed base member or pivot base member, so as to define a plurality of fixed angled positions at which the pivot base member may pivot with respect to the fixed base member. Thus, there may be a finite number of positions at which the fixed base member 24 and the pivot base member 26 may be positioned relative to one another. On the other hand, the rotatable stem 34 is infinitesimally rotationally moveable about its longitudinal axis within the cylindrical stem-receiving socket 32. At the same time, the rotatable stem 34 may be secured in place within the stem-receiving socket such as by means of a "O"-ring or similar structure. In this case, the "O"-ring may comprise one or a pair of machined rings or elements, or it may comprise more conventional rubber or plastic "O"-rings which, in any event, frictionally engage the rotatable stem 34 within the cylindrical stem-receiving socket 32, so as to provide resistance to rotational movement of the rotatable stem with respect to the stem-receiving socket.

The pivot mounting screw 42 may, indeed, take the structure of a machine bolt which may be tightly engaged in the pivot yoke 36 so as to provide adjustment whereby the pressure by which the pivot stem 38 is received in the pivot yoke 36 may be adjusted. This, in turn, may provide for somewhat more easy adjustment or somewhat stiffer adjustment of the positioning of the elongate main arm 40 with respect to the rotatable stem 34. This, in turn, together with the engagement between the rotatable stem 34 and the stem-receiving socket 32, and the respective engagement between the elongate main arm 40 and the first telescopic element 44, and together with the detent pivoting arrangement at the base, permits the arm and the microphone assembly 16 mounted at its end to absorb bumps and shocks to which the vehicle may be subjected. In that sense, the mounting arm assembly 18 may, itself, function like a shock absorber, so that no sudden shocks or bumps absorbed by the vehicle will result in noise such as a thump or pop which might be heard by the party listening to a call from the driver of the vehicle where the mounting arm is placed.

The design of the arm is such that, even its thickest element such as the

dimension of the elongate main arm 40, may have a maximum diameter of no more than about 7 to 10 millimeters, usually about 7 millimeters. In that manner, there will be no particularly noticeable obstruction before the face of the driver, and nothing to obscure the vision of the driver. To avoid glare or reflection, the entire mounting arm assembly of the present invention is typically finished with a matte black, non-glare finish, or other non-reflecting finish.

Referring specifically to Figure 3, pivotal movement of the pivot base member 26 with respect to the fixed base member 24, about the first pivot axis defined by the axis of the base mounting pivot bolt 30, is illustrated by the double-headed arrow 54. An alternative position for the mounting arm assembly is shown in dashed lines in Figure 3.

Likewise, rotational movement of the rotatable stem 34 inserted into the cylindrical stem-receiving socket 32 is demonstrated by the double-headed arrow 56 in Figure 4. As noted, rotation of the rotatable stem 34 within the stem-receiving socket 32 may be in infinitesimally small steps; with an "O"-ring or like engagement around the rotatable stem 34 so as to provide resistance to rotational movement in the manner shown by double-headed arrow 56.

In a similar manner to Figure 3, Figure 5 shows yet further alternative rotational movement of the elongate main arm around the pivot stem defined by the pivot mounting screw 42, as shown by double-headed arrow 58. Here, pivotal movement is, as noted above, effected by pivoting the pivot stem 38 about the second pivot axis through a continuum of angled positions. An alternate position of the mounting arm assembly is also shown by dashed lines in Figure 5.

Turning to Figure 6, the telescopic movement of the microphone assembly 16 relative to the base 20 is illustrated, with a first or initial position of the microphone assembly being shown in dashed lines and a final position being as indicated by Figure 6. The telescopic movement is effected in the direction indicated by double-headed arrow 60. In Figure 6, the first telescopic element 44 is shown as having been withdrawn and extended away from the elongate main arm 40; further telescopic movement can, of course, be effected by the interrelation between the second telescopic element 46, when present, together

with the first telescopic element 44.

Turning now to Figure 7, a plurality of arrows 62 demonstrates adjustment of the position of the microphone assembly 16 by adjustment of the gooseneck element 48. Here, the gooseneck element may move in any one of a number of directions, within the limitations permitted by the construction of the gooseneck element, but generally as shown by the arrows 62. Thus, final adjustment of the position of the microphone assembly 16 having regard to the mouth 15 of the driver 14, is effected.

As will be described hereafter, there are at least a pair of wires leading from the radio frequency operating device to the microphone assembly. In keeping with a particular feature of the present invention, so as to provide radio frequency shielding for those wires, they are typically passed through the interior of the mounting arm assembly 18 which comprises a plurality of hollow tubes. The wires, which may be one or more pairs of wires which are appropriately shielded by their own wire shielding structure, will in any event have a general configuration and appearance as a microphone cable 64.

Referring particularly to Figure 10, a wire guide 66 is provided, and it forms part of the structure of the elongate main arm 40. The arm 40 is shown in cross-section in Figure 10, and the wire guide 66 is shown being clipped to the main arm 40. Typically, the wire guide 66 is molded from plastic and has a pair of wire guide clip arms 68 which nearly encompass the outer circumference of the arm 40. A wire exit hole 70 is formed in the structure of the arm 40, so that the microphone cable 64 passes from the exterior of the arm 40 into the interior of the arm 40 and thence through the remaining structural components of the mounting arm 18, up to the microphone assembly 16. The wire guide 66 is formed with an outer guide member 72, which is such that the microphone cable 64 can pass through the outer guide member 72 and the wire exit hole 70 into and out of the exterior of the arm 40 without becoming entangled. Thus, as the telescopic arm is shortened or lengthened, as particularly illustrated in Figure 6, the microphone cable 64 can freely pass into and out of the interior of the mounting arm assembly 18 without ripping or damaging the wire, and without

damage to or catching the wire on the main arm 40.

As noted, the microphone mounting arm assembly 10 includes the mounting clip 22, which is shown in Figure 12. The mounting clip 22 permits the mounting arm assembly 18 to be mounted in a removable manner to a mounting position on the interior of the vehicle passenger compartment. The mounting and de-mounting of the mounting arm assembly 18 is accomplished at its base 20, which is received by and secured to the mounting clip 22. The mounting clip comprises a main body 74 which has a front panel 76 and a rear panel 78. As viewed in Figure 12, each of the front panel 76 and rear panel 78 have left and right edges, and top and bottom edges; each panel has front and rear faces; and the front and rear panels 76, 78 are joined together and comprise a unitary body by being joined along their respective bottom edges generally as shown at 80. The unitary body of the clip 22 is formed from a resiliently deformable material, preferably spring steel, which material is such that it has a modulus of elasticity so that the front and rear panels 76, 78 are openable and elastically closable one with respect to the other at their top edges 82, 84. So as to more easily effect spreading the front and rear panels 76, 78 apart at their respective top edges, a lip 86 is formed so as to be directed upwardly and outwardly at the top of the front panel 76, as shown.

The fixed base member 24 of the base 20 of the microphone mounting arm assembly 10 is received on the front face 76 of the clip 22 over a pair of studs (not shown) and is secured thereto by tightening a pair of nuts 88 over the studs after the studs have passed through mating holes formed in the fixed base member 24.

Conveniently, a pair of slots 90 may be formed in the front panel 76 near each end thereof, which slots may extend past the bottom 80 and slightly upwardly into the rear panel 78. The slots provide for more easy mounting and de-mounting of the clip 22 such as to the trim over a driver's door in a vehicle or under the head liner in the same general position over the driver's door. The slots 90 also provide the advantage that, because the slots 90 extend past the bottom 80 and into the rear panel 78, the clip 22 functions in some respects as

three clips. Each of the three discrete portions of the front panel 76 may be individually operable, so as to be disengaged from vehicle trim or head liner, thereby requiring some additional effort to de-mount the clip. Moreover, there will be provided three discrete points or areas for contact by the inner surface of the front panel 76 behind the lip 86. Some curvature of the vehicle body structure where the clip 22 is being mounted may, therefore, be accommodated.

Obviously, depending on the manner of mounting the clip 22, it may be faced upwardly as shown in Figure 12, or it may be inverted so as to face downwardly. The studs and their related nuts 88, however, are presented in appropriate orientation so that the fixed base member 24 of the base 20 may be removably mounted to the clip 22.

A plurality of spaced apart prongs 92 are formed in the rear face 78, so as to project outwardly from the front face of the rear panel and generally towards the front panel. Each of the prongs is shaped and dimensioned so as to engage the material on the interior of the vehicle passenger compartment, such as plastic trim over the driver's door or the head liner material, and so as to be in supported relation on that vehicle passenger compartment material.

Typically, the plurality of prongs 92 are angled so as to project toward the bottom edge 80 of the rear panel 78; and, typically, there is at least one and usually a pair of prong 92 disposed towards each of the left edge and rear edge of the rear panel 78, with the prongs 92 shown being disposed towards the right edge of the rear panel 78 in Figure 12. In general, there may be at least four prongs, with two prongs each at the left edge and right edge of rear panel 78; or there may be eight prongs with four additional prongs arranged generally centrally in rear panel 78.

Referring now to Figure 11, the contribution of the mounting arm shown generally as 18, both mechanically and electrically, is now more evident. The microphone assembly 16 and the base 20 are shown in general detail. The microphone assembly 16 includes a microphone element 94, and a microphone shield element 96. The microphone element 94 may typically be a carbon microphone or other microphone having a small active element, such as a ribbon

microphone. However, superior results are achieved when the microphone element is that of a condenser microphone.

In the broadest sense, however, the radio frequency operating installation which comprises the microphone assembly 16 also will comprise a radio frequency transmitter and a radio frequency receiver which, together, function as a radio frequency operating device. As noted above, that may be a cellular telephone, or it may also be CB radio, or a trunk or non-trunk two-way radio. Within the radio frequency operating device, shown generally at 98, or associated with it, there will be an antenna 100, an amplifier and signal converter which are shown generally at 102, and a source of direct current power such as battery 104. The battery 104 provides the operating power for the amplifier and signal converter 102, and generally for the radio frequency operating device 98 so that signals may be sent and received therefrom using antenna 100. In some instances, multiple antennas may be used.

The microphone element 94 is connected to the amplifier and signal converter 102 by at least two wires, a voice neutral wire 106 and a voice signal wire 108. Often, the microphone element 94 may be a balanced microphone, having a pair of voice signal wires, or a voice signal wire together with a voice neutral wire and a further shielding wire. However, in the strictest sense and in keeping with the present invention, the further shielding wire may well be unnecessary.

As noted above, the general structure of the mounting arm 18 is such that it is a hollow conductive tube or tubes, including the elongate main arm 40, telescopic elements 44, 46, the gooseneck element 48, and an extender arm 50. In any event, the entire structure is hollow and is made of an electrically conductive material. The voice neutral wire and voice signal wire 106, 108 are passed through the hollow tube of the mounting arm 18 from the microphone element 84 up to the point where they exit from the mounting arm at wire guide 66. Thereafter, the microphone cable 64 is provided, and it typically may be four conductor cable having a full braided seal or shield. The shield is shown at 110, so as to provide appropriate shielding in the usual manner for the voice signal

wires as they are directed to the radio frequency operating device 98.

However, unlike other installations for a remote or hands-free microphone installation within a vehicle, the present invention provides for a microphone installation where the signal quality of the speech is essentially clean and without background noise or radio frequency interference. This is accomplished, at least in part, by the provision of the mounting arm 18 through which the signal wires are fed; and thus, the mounting arm structure 18 becomes part of the microphone both physically and electrically.

This is shown even more clearly because the microphone shield element 96 is electrically connected to the mounting arm structure 18, as at 112. Thus, since the conductive mounting arm 18 is secured to the electrically insulating base 20, which in turn is mechanically mounted to the interior surface of the body of the vehicle 12, it is seen that the microphone assembly 16 including the microphone element 94 and the microphone shield element 96 is electrically isolated from the vehicle ground because it is not electrically connected to the body or chassis of the vehicle. This, in turn, provides radio frequency shielding for the microphone element 94 and for the voice signal wires 106, 108, which pass through the conductive mounting arm 18.

Where the microphone element 94 is that of a condenser microphone, then it must also be connected to the source of direct current power for the radio frequency operating device 98, and thus it is connected to battery 104 by a power neutral wire 114 and a power signal wire 116. In the usual case, however, and as shown in Figure 11, the voice neutral wire 106 and the power neutral wire 114 may physically be the same wire. The power neutral wire and the power signal wire 114, 116 are also passed through the mounting arm 18.

By so doing, there is provided radio frequency shielding not only for the microphone element and the voice signal and voice neutral wires, but also for the power signal and power neutral wires. This, in turn, provides at least two further advantages.

Since there is a possibility that, if the arm were to be electrically connected to the body of the vehicle — in other words, either or both of the fixed base

member 24 and the pivot base member 26 would not be manufactured from an electrically insulating material — there is a possibility that there would be a different ground potential than the ground or neutral potential connected to the microphone element both by the voice signal neutral wire and the power signal neutral wire. If so, then ground loops could occur which, in turn, create considerable hum which would be heard by the party being called from the vehicle; and that hum could be so bad as to drown out any speech. Thus, by electrically insulating the arm assembly from the vehicle ground, ground loops and hum are precluded.

Still further, by electrically connecting the microphone shield element 96 to the mounting arm 18, the microphone assembly 16 is essentially shielded. That means that it is possible for the hand of the driver 14 to touch the mounting arm assembly 18 without there being a snap sound being generated in the signal line as a consequence of static discharge into the arm assembly by the person touching it. Thus, as noted above, the arm assembly is manufactured from a conductive material. Typically, the structure of the elongate main arm 40, the telescopic elements 44, 46, the gooseneck element 48, and the extender arm 50, may be manufactured from brass; however, aluminum, chromium steel, or copper, are also good electrically conductive materials which may be utilized. Also, as noted above, the exterior surface of those elements may be anodized or otherwise coated with a matte black or dull gray coating or color, so as to preclude the possibility of visual glare and so as to not obscure the vision of the driver.

From the above, it is seen that the structure of the mounting arm 18 provides appropriate shielding, and in effect it becomes a primary shield for the power and voice signal wires, particularly in the location where they are most vulnerable to radio frequency interference. Radio frequency interference is sometimes termed "RF blowthrough", and it may come as a consequence of the electrical system within the vehicle — especially when the vehicle is one that has many of its functions that are under the control of an on-board computer — or RF blowthrough may come as a consequence of radio frequency transmissions coming from sources that are external to the vehicle. In either event, in one

sense, the mounting arm structure 18 might appear to function as a radio antenna; but, on the other hand, by being manufactured from a conductive material which is connected to the microphone shield element 96, but which is not otherwise connected to the vehicle chassis or ground, effective shielding is provided.

The microphone assembly 16, and particularly the microphone element 94, are most effective when the microphone element is designed so as to have a narrow active field and a small pick-up pattern. Thus, the microphone is essentially uni-directional, so as to preclude pickup of external or background noise. Especially when the active field is such that the pick-up pattern is most effective at a range of from about 6 to 20 centimeters, usually about 8 or 10 centimeters, the clarity of speech signals transmitted, and thus the clarity of speech reproduction in the voice amplifying apparatus being used by the called party, is quite surprisingly superior to that which has previously been achieved.

Figure 11 also suggests that, in certain circumstances, the radio frequency operating device 98 may, indeed, be connected to the vehicle battery 118 and grounded to the vehicle chassis 120. Those connections are shown in dashed lines in Figure 11. In those circumstances, a common grounding point 122 on the radio frequency operating device 98 is connected to the vehicle chassis 120 and, in the embodiment shown, the negative terminal of the vehicle battery 118. However, it is evident from a review of Figure 11 that the only ground connection throughout the entire installation of the microphone mounting arm assembly 10 is at the ground point 122 to the chassis 120. It is understood, of course, that the negative terminal of battery 118, in this instance, is also directly connected to the vehicle ground or chassis 120.

There has been described an assembly for a microphone in a radio frequency operating device in a vehicle, where the radio frequency operating device is in wireless communication such as by cellular telephone, citizens' band radio, or two-way radio, with other parties or other stations. The assembly is such that the quality of speech reproduction is very high because the microphone is placed safely and conveniently just in front of the mouth of the driver of the vehicle, so as to provide for hands-free operating of the radio frequency operating

device. The speech signals conveyed from the microphone to the radio transmitting apparatus are effectively shielded at all points, so as to preclude RF blowthrough; and the signal and power wires, where used, are operated within their own voltage domain without the risk of ground loops developing because various elements had been grounded at various points in the body of the vehicle, which points may be at different ground potentials than the ground or neutral potential in the radio frequency operating device, and at different ground potentials from the chassis or vehicle ground as it is defined by the grounding connection of the vehicle battery to the vehicle chassis.

In an alternative embodiment, it may be possible for the signal wires and the power wires to be laid along side and taped to the mounting arm structure 18; and, if so, the chances for RF blowthrough and ground loop noises developing would be lessened if the signal wires and the power wires for the microphone element are contained in a braided shielded cable structure. If the mounting arm structure 18 is conductive, then the shielding, such as shown at 110 for the microphone cable 64, should be electrically connected to the mounting arm structure; and if the mounting arm structure might be formed of plastic or other non-conductive material, then the only shielding against RF blowthrough would be that provided by the braided shield structure of the cable. On the other hand, by being otherwise isolated from the vehicle chassis, the risk of hum due to ground loops is diminished.

The microphone mounting arm assembly may be removed from one vehicle to another without damage to the vehicle; and, because the mounting clip may be mounted in a variety of positions, it may be secured to various parts of the vehicle structure including trim around a window or the head liner material of the vehicle.

The structure of the microphone mounting arm is such that it is small and unobtrusive so that it will not obscure the vision of the driver. There are a number of adjustment points, all of which may be arranged so as to have some reasonable resistance to adjustment, so that when the arm is mounted in the vehicle, and especially when the microphone is placed in front of the driver's

mouth, it will not shift its position as the vehicle encounters bumps or shocks. The microphone mounting arm assembly may be easily folded up against the roof of the vehicle when not in use, and easily pulled down into position when in use, using only one hand. Thereafter, the driver may again assume full control of his vehicle with both hands.

Other modifications and alterations may be used in the design and manufacture of the apparatus of the present invention without departing from the spirit and scope of the accompanying claims.

WHAT IS CLAIMED IS:

1. A microphone mounting arm assembly (10) for mounting a microphone assembly (16) in a vehicle (12), wherein said microphone assembly includes a microphone element (94) of a radio frequency operating installation (98) in said vehicle, wherein said radio frequency operating installation comprises said microphone assembly, at least a radio frequency transmitter and a radio frequency receiver functioning together as a radio frequency operating device, and wherein said microphone assembly is connected to said radio frequency operating device and is mounted so as to be selectively positionable near the mouth (15) of the user (14) of the radio frequency operating installation; said microphone mounting arm assembly being c h a r a c t e r i z e d by:

a fixed base member (24) adapted for secure mounting onto a mounting clip (22);

a pivot base member (26) mounted to said fixed base member for selective pivotal movement about a first pivot axis to any one of a plurality of angled positions;

wherein at least one of said fixed base member and said pivot base member is electrically insulative;

wherein said pivot base member includes a substantially cylindrical stem-receiving socket (32);

a rotatable stem (34) having a longitudinal axis and first and second ends with the first end being inserted in said stem-receiving socket for selective rotational movement about said longitudinal axis and a pivot yoke (36) projecting outwardly at said second end thereof;

an elongate main arm (40) having a first end and a second end with a pivot stem (38) projecting outwardly at said first end, and being retained by said pivot yoke of said rotatable stem for pivotal movement about a second pivot axis through a continuum of angled positions, said elongate main arm having at least one telescopic element (44) inserted thereinto at said second end thereof;

a gooseneck element (48) mounted on said at least one telescopic element at a first end thereof which is remote from a second end inserted into said second end of said elongate main arm;

said microphone assembly containing said microphone element being mounted at said gooseneck element at the end thereof remote from said at least one telescopic element;

whereby said microphone assembly is selectively positionable near the mouth of the user by selective adjustment of any of said pivot base member about said first pivot axis with respect to said first base member, said rotatable stem within said stem-receiving socket for rotational movement about said longitudinal axis, said elongate main arm about said second pivot axis with respect to said rotatable stem, said at least one telescopic element with respect to said elongate main arm, and said gooseneck element.

2. The microphone mounting arm assembly of claim 1, further comprising a metal collar (45) having a set screw (47), wherein said metal collar is placed at the end of said at least one telescopic element which is remote from the end inserted into said second end of said elongate main arm, and wherein said metal collar is retained in place by said set screw which passes through said metal collar and said at least one telescopic element to engage said gooseneck element and thereby provide electrical continuity between said gooseneck element and said eleongate main arm.

3. The microphone mounting arm assembly of claim 1, further comprising an extender arm (50) mounted between said gooseneck element and said microphone body.

4. The microphone mounting arm assembly of claim 1, wherein said fixed base member and said pivot base member each comprise a plurality of co-operating detent portions, which detent portions on each of said fixed base

member and pivot base member interact with the detent portions on the other of said fixed base member and pivot base member to thereby define said plurality of fixed angled positions of said pivot base member with respect to said fixed base member.

5. The microphone mounting arm assembly of claim 1, wherein said rotatable stem is infinitesimally rotationally movable about said longitudinal axis, and is secured in place in said stem-receiving socket by means of an "O"-ring, which "O"-ring frictionally engages said rotatable stem to thereby provide resistance to rotational movement of said rotatable stem with respect to said stem-receiving socket.

6. The microphone mounting arm assembly of claim 1, wherein said second pivot axis is defined by a machine bolt 42 tightly engaged in said pivot yoke so as to provide adjustment means for selectively adjusting the pressure of said yoke on said pivot stem of said elongate main arm.

7. The microphone mounting arm assembly of claim 1, wherein said elongate main arm, and said at least one telescopic element, and said gooseneck element are all constructed of an electrically conductive material, and all have a hollow construction through which wires may be passed; and

wherein a wire exit hole (70) is placed at the end of said elongate main arm at a point near said pivot base member, and a wire guide (66) is mounted with an outer guide member (72) in communication with said wire exit hole, whereby wires may be passed from the hollow interior of said elongate main arm through said wire exit hole and said outer guide member to the exterior of said microphone mounting arm.

8. A microphone mounting arm assembly (10) for a microphone assembly (16) in a radio frequency operating installation in a vehicle (12),

wherein said radio frequency operating installation (98) includes a microphone assembly (16), a radio frequency transmitter and a radio frequency receiver functioning together as a radio frequency operating device, an antenna (100), an amplifier and a signal converter (102), and a source of direct current power (104); said microphone mounting arm assembly being c h a r a c t e r i z e d in that:

said source of direct current power provides the operating power for said amplifier, signal converter, and said radio frequency operating device;

said microphone assembly is mounted in a vehicle on a mounting arm (18), so as to be selectively positionable near the mouth (15) of the user (14) of said radio frequency operating installation, and includes a microphone element (94) which is connected to said amplifier by at least a voice neutral wire (106) and a voice signal wire (108);

said mounting arm being constructed of an electrically conductive material in the form of a hollow tube, wherein said voice neutral wire and said voice signal wire are passed through said hollow tube of said mounting arm from said microphone element;

said microphone assembly further including a microphone shield element (96) for said microphone element, said microphone shield element being electrically connected to said mounting arm; and

said mounting arm being secured to an electrically insulating base (20) which is mechanically mounted at a mounting position on an interior surface of the body of said vehicle;

whereby said microphone shield element and said mounting arm are electrically isolated from a vehicle ground, and provide radio frequency shielding for said microphone element and for said voice signal and voice neutral wires passed through said mounting arm.

9. The microphone mounting arm assembly of claim 8, wherein said microphone is a condenser microphone, and wherein said microphone element is

connected to said source of direct current power by a power neutral wire (114) and a power signal wire (116) which are passed through said hollow tube of said mounting arm;

whereby said power neutral wire and said power signal wire are provided radio frequency shielding by being passed through said mounting arm.

10. The microphone mounting arm assembly of claim 9, wherein said power neutral wire and said voice signal neutral wire are the same wire.

11. The microphone mounting arm assembly of claim 8, wherein said mounting arm is telescopic, so as to change its length, and wherein said mounting arm is constructed of an electrically conductive material chosen from the group consisting of brass, aluminum, chromium steel, and copper.

12. The microphone mounting arm assembly of claim 9, wherein said power wires and said voice signal wires exit from the interior of said mounting arm through a wire guide (66) at a point near said electrically insulating base in such a manner as to be free to move into and away from said exit point as said telescopic mounting arm is changed in length by passing through an outer guide member (72) arranged in said wire guide, without damage to said wires.

13. The microphone mounting arm assembly of claim 11, wherein said microphone element is designed so as to have a narrow active field and a small pick-up pattern, and so as to be essentially unidirectional, and wherein said active field is such that the pick-up pattern is most effective at a range of from 6 to 20 centimeters.

14. The microphone mounting arm assembly of claim 11, wherein said electrically insulating base is made from a material chosen from the group consisting of nylon, polypropylene, polyvinyl chloride, and polyethylene.

15. A mounting clip (22) for use with a microphone mounting arm assembly (10) for mounting said microphone mounting arm assembly in a removable manner to a mounting position on the interior of a vehicle (12) passenger compartment, wherein said microphone mounting arm assembly includes an electrically insulating base (20) which is intended to be received by and secured to said mounting clip, said mounting clip being c h a r a c t e r i z e d by:

a main body (74) including a front panel (76) having top (82) and bottom edges, left and right edges, and front and rear faces, and further including a rear panel (78) having top (84) and bottom edges, left and right edges, and front and rear faces, wherein said front and rear panels comprise a unitary body and are joined together along their respective bottom edges (80);

wherein said unitary body is formed from a resiliently deformable material having a modulus of elasticity such that said front and rear panels are openable and elastically closable one with respect to the other at their respective top edges;

an insulating base receiving means (88) disposed on the front face of said front panel; and

a plurality of spaced apart prongs (92) projecting outwardly from the front face of said rear panel, generally towards said front panel, wherein said prongs are each shaped and dimensioned to engage the material on the interior of said vehicle passenger compartment in supported relation thereon.

16. The mounting clip of claim 15, wherein said plurality of prongs are angled so as to project toward the bottom edge of said rear panel; and

wherein said plurality of prongs are disposed such that at least one prong is disposed toward said left edge of said rear panel and at least one prong is disposed toward said right edge of said rear panel.

17. The mounting clip of claim 15, wherein said main body is made

from spring steel, wherein a pair of slots (90) is formed in said front panel so as to form several discrete portions thereof, and wherein each of said discrete portions of said front panel is individually openable with respect to said rear panel.

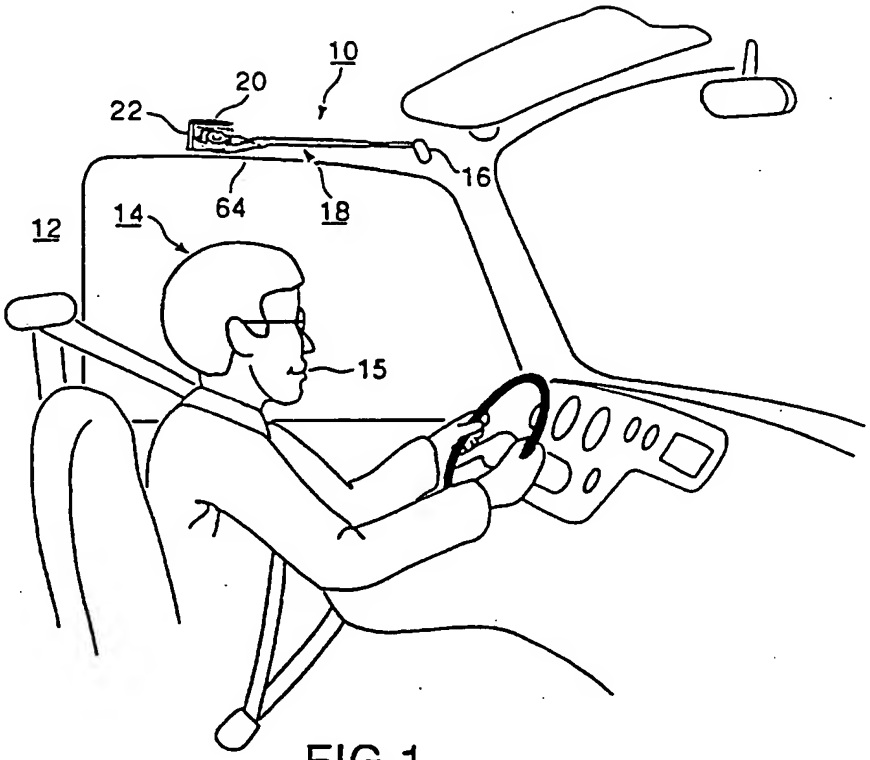

FIG 1

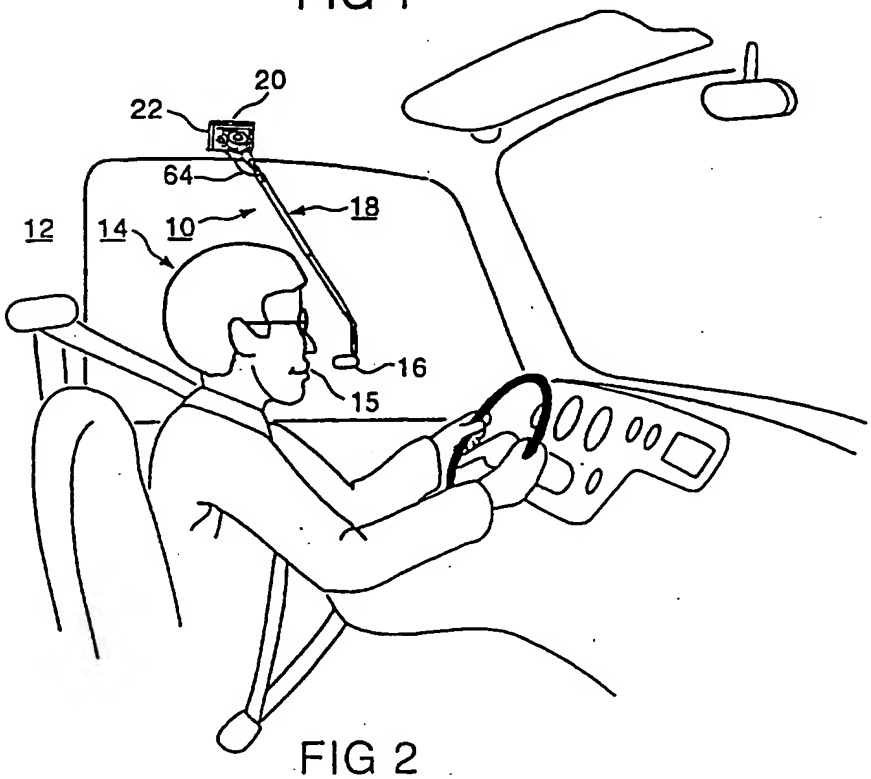

FIG 2

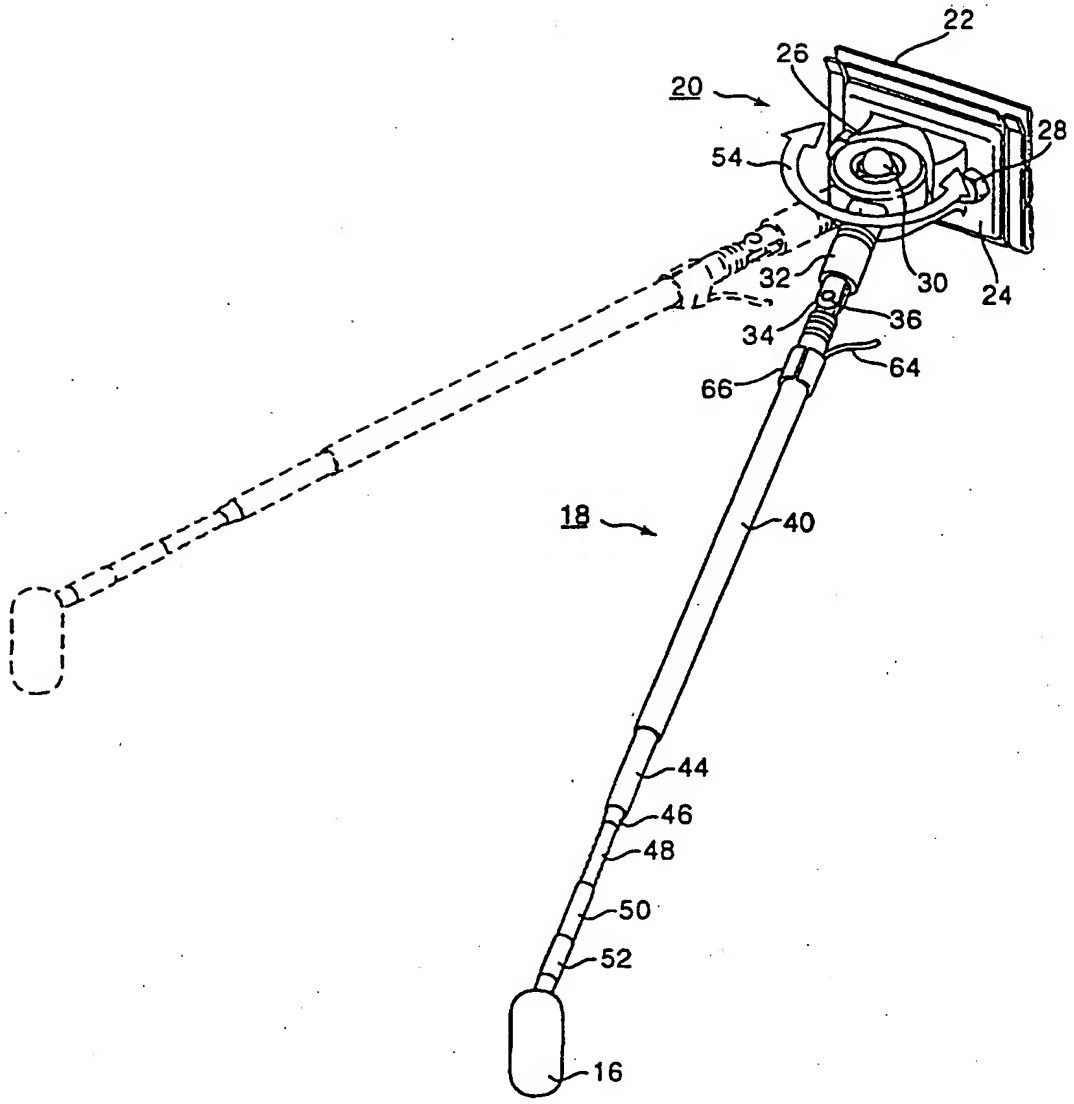

FIG 3

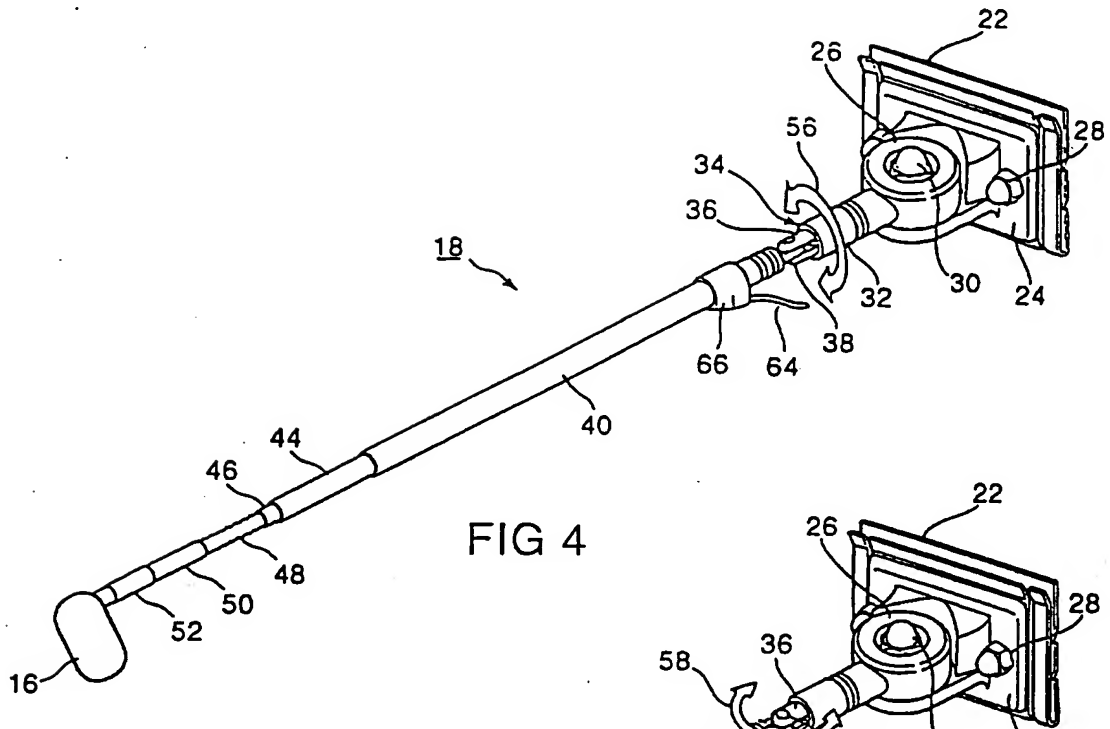
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FIG 4

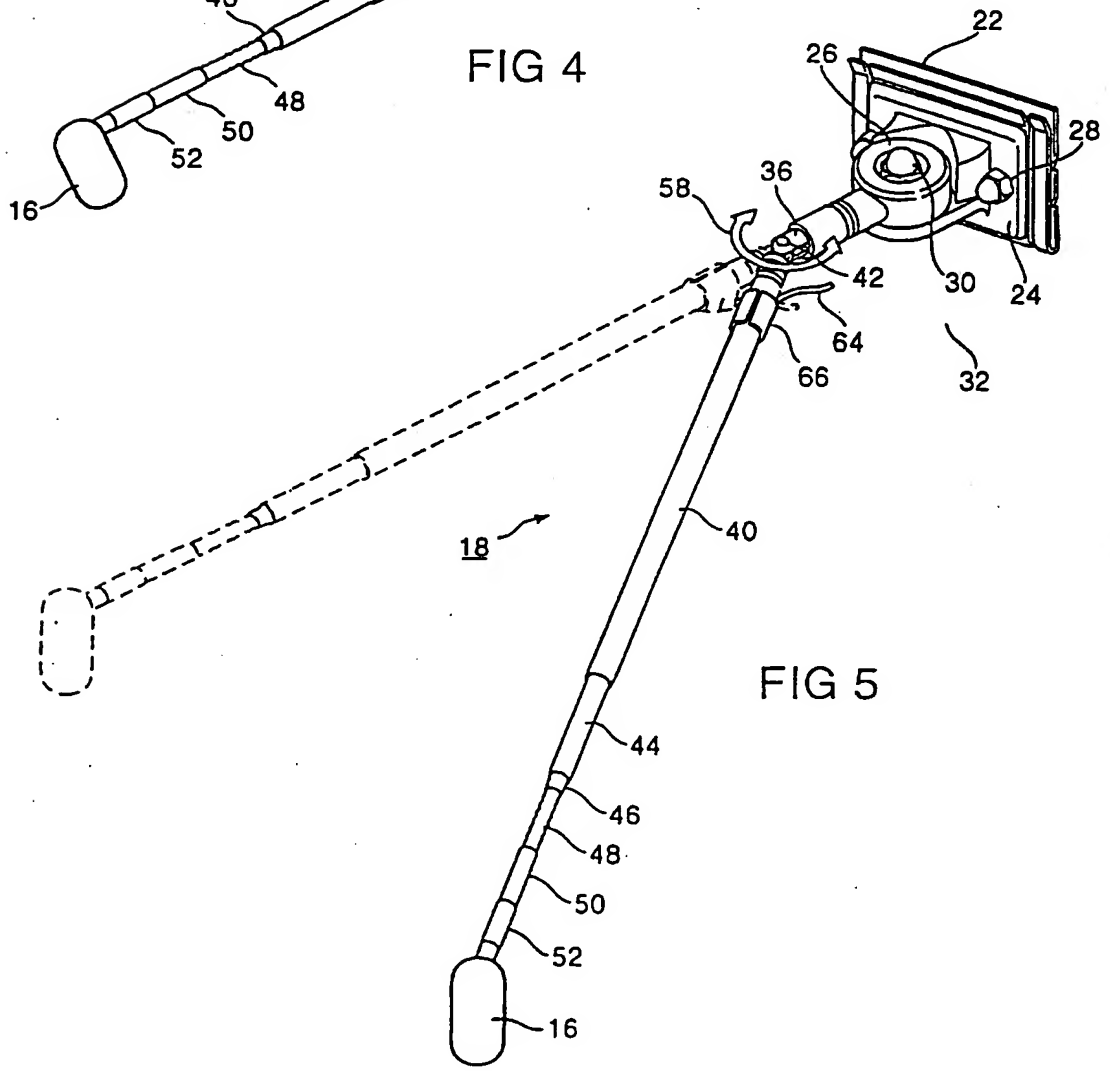
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FIG 5

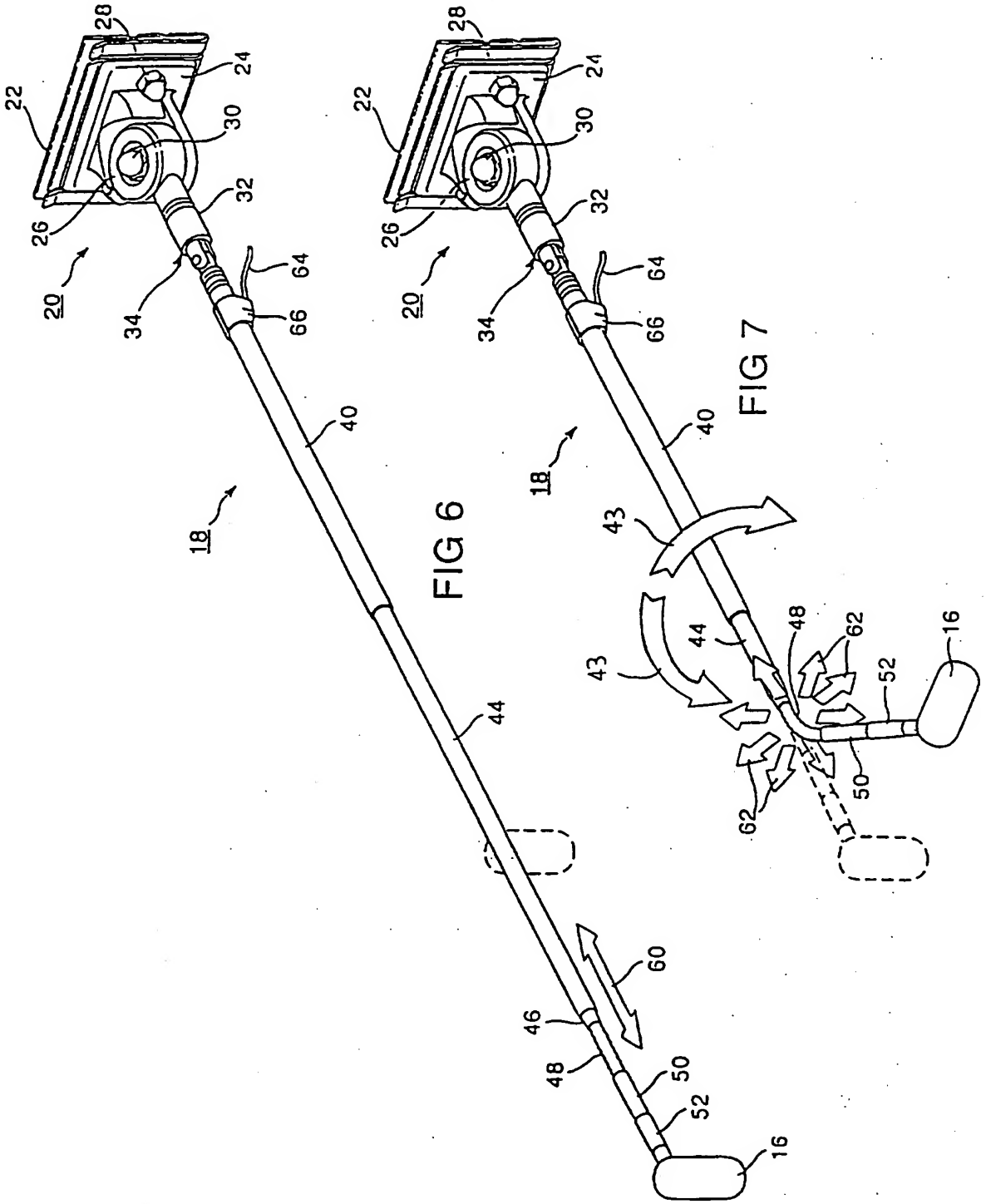
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FIG 6

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FIG 7

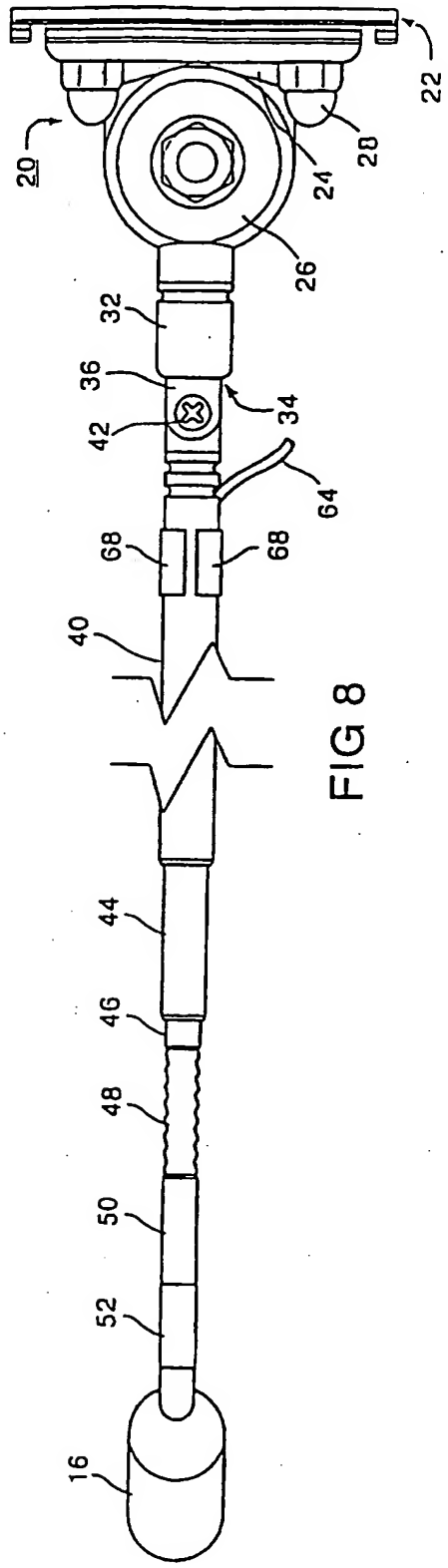

FIG 8

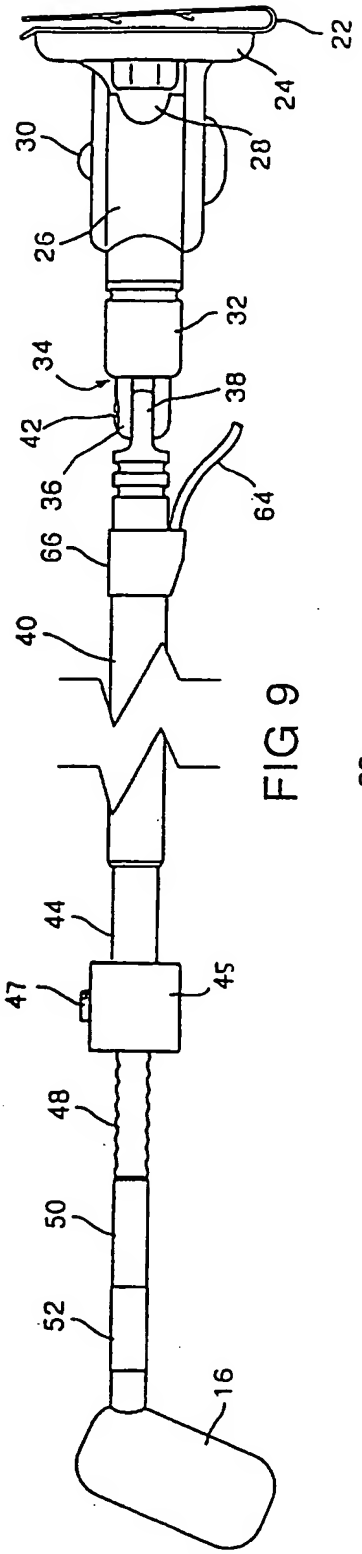

FIG 9

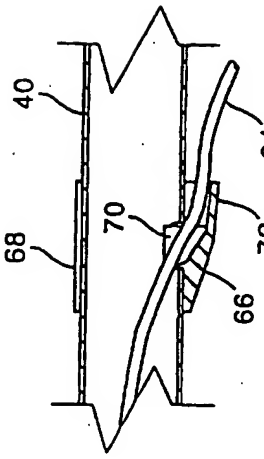

FIG 10

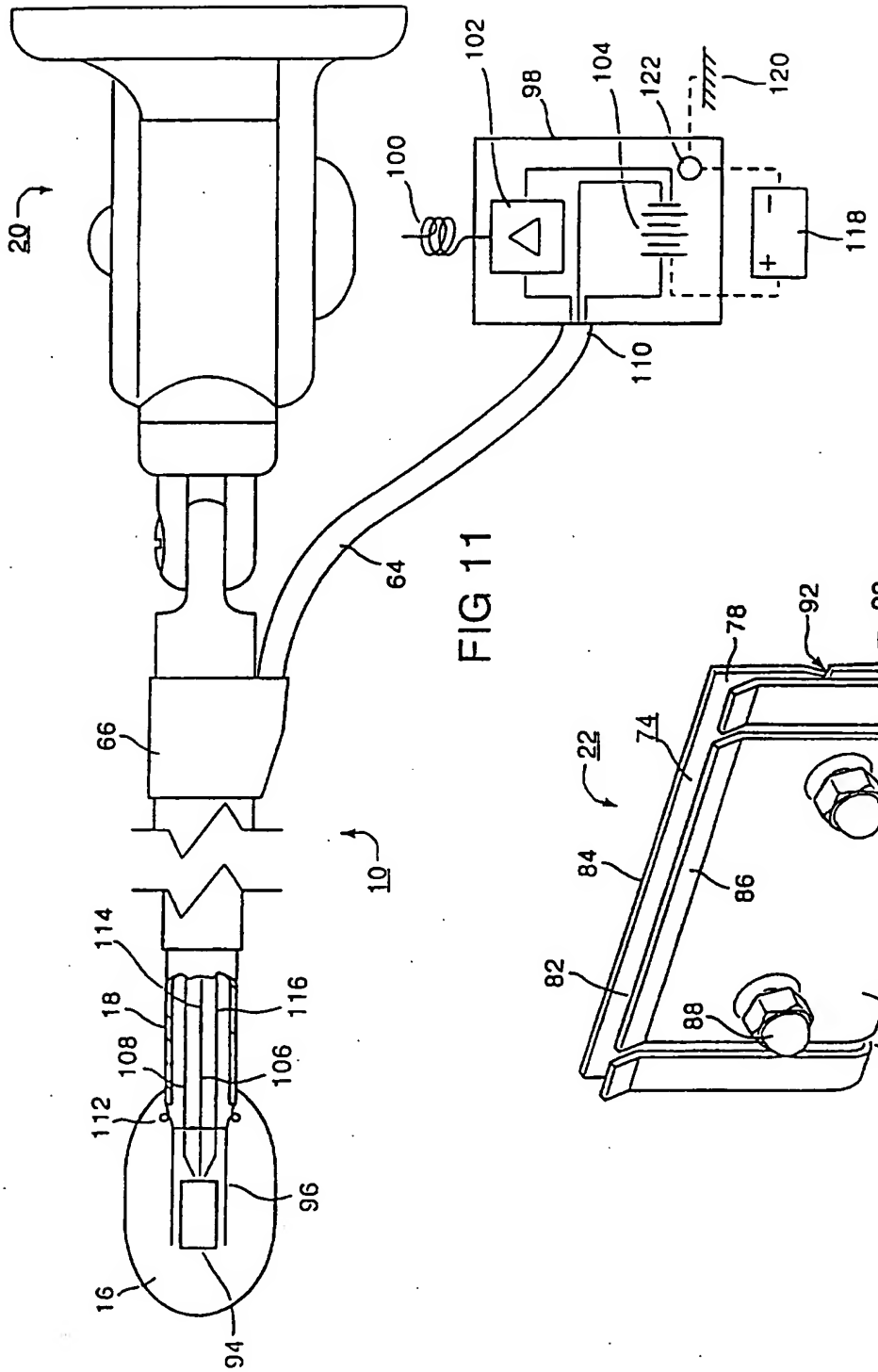
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FIG 11

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FIG 12

INTERNATIONAL SEARCH REPORT

Interna' nal Application No
PCT/EA 96/00210

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04R1/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04R F16B F16M B60R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,4 060 697 (NEAL) 29 November 1977 see column 2, line 25 - column 4, line 3 ---	1,7,8,11
A	GB,A,2 210 233 (MITSUBISHI) 1 June 1989 see page 1, line 1-2 see page 6, line 5-21 see page 8, line 16 - page 10, line 9 ---	1,8,9,13
A	US,A,4 853 965 (BLONSKI) 1 August 1989 see column 2, line 56 - column 3, line 1 see column 3, line 11 - column 4, line 59 ---	1,2,4-8, 11
A	US,A,4 355 213 (MARSH) 19 October 1982 see column 1, line 25-35 see column 1, line 48 - column 3, line 2 --- -/--	1-3,7-12

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

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Date of the actual completion of the international search	Date of mailing of the international search report
19 July 1996	12.08.96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+ 31-70) 340-3016	Zanti, P

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 96/00210

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB,A,2 235 239 (CANNON RUBBER) 27 February 1991 see page 1, line 2 - page 4, line 22 see page 5, line 14 - page 12, line 17 ---	1,4, 15-17
A	US,A,3 924 083 (HAGEY) 2 December 1975 see column 2, line 23 - column 4, line 37 -----	1,8,14, 15

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INTERNATIONAL SEARCH REPORT

.ormation on patent family members

Inter· ·nal Application No
PC1,CA 96/00210

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		JP-B- 7036578	19-04-95
		AU-B- 604390	13-12-90
		AU-B- 2704488	22-06-89
		US-A- 4905270	27-02-90
US-A-4853965	01-08-89	NONE	
US-A-4355213	19-10-82	NONE	
GB-A-2235239	27-02-91	NONE	
US-A-3924083	02-12-75	NONE	